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ABSTRACT

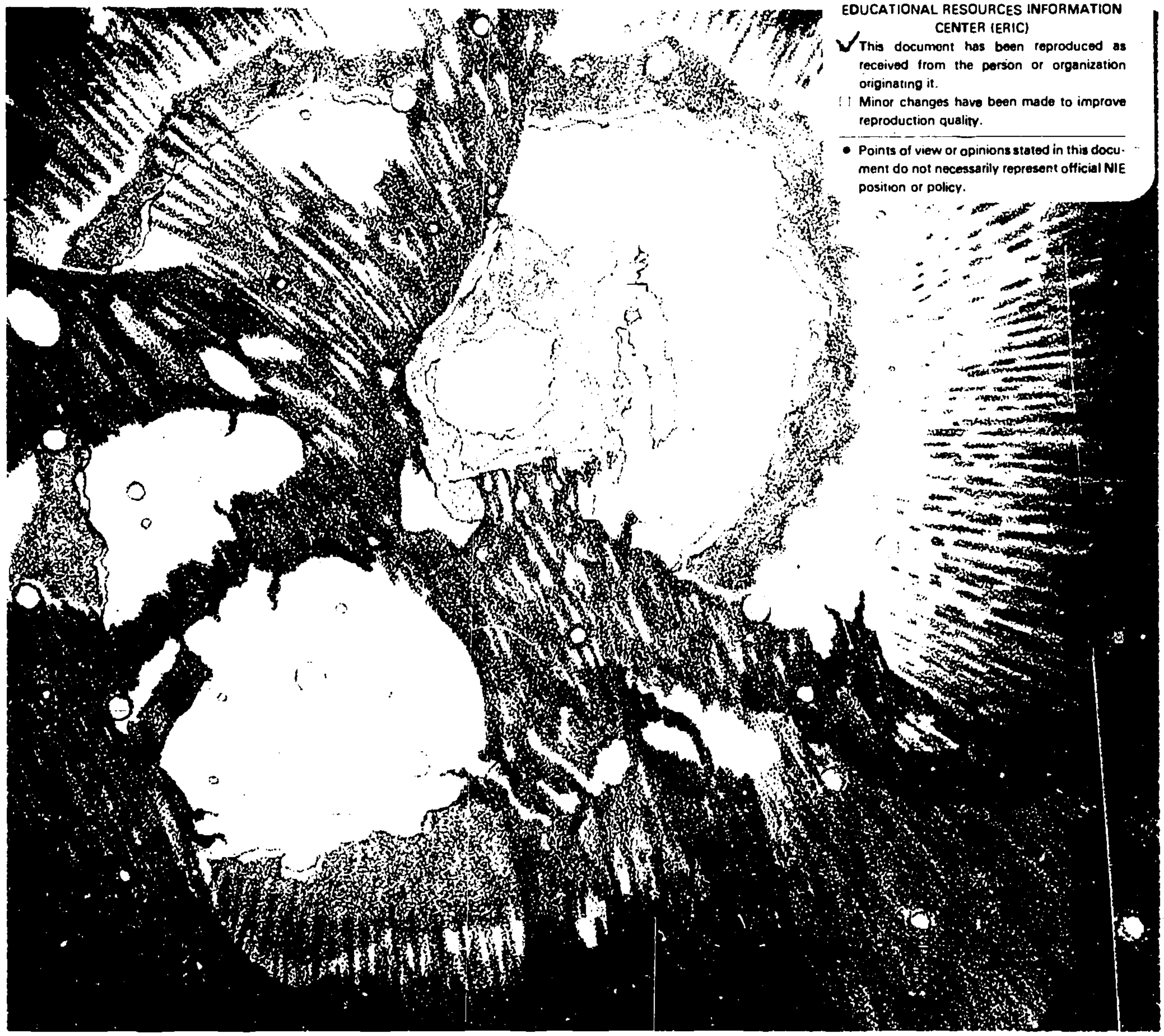
This teacher guide for the astronomy unit of an outdoor education program consists of a series of performance objectives, intended to provide interesting, hands-on activities, involving interdisciplinary skills, that augment commitments of the mathematics, sciences, and social studies program of the Montgomery County (Maryland) Public Schools. Each activity is arranged sequentially according to the skills involved and outlines specific objectives, procedures, materials required, special considerations, and evaluation techniques. The 12 daytime activities are determining time with a shadow stick, making and using a sundial, finding direction without a compass, using a watch to locate north, measuring angles with fists, measuring and locating sky objects on the azimuth, making a simple astrolabe, measuring objects above the azimuth, using an astrolabe to measure the angle of the sun's rays, determining the "altazimuth" of objects, making a model of our solar system, and constructing and using a spectroscope. The five suggested nighttime astronomy activities are determining cardinal direction, using an astrolabe to measure the altitude of stars, observing apparent movement of stars, photographing star trails, observing meteors, and locating Polaris, Ursa Major, Ursa Minor, and Cassiopeia. Glossaries of stars, constellations, and terms are included, as is a bibliography. (NEC)

MONTGOMERY COUNTY PUBLIC SCHOOLS · ROCKVILLE, MARYLAND

Activities for Studying

Heavenly Bodies

1979



Outdoor Education Series · Bulletin No. 247-M

OUTDOOR EDUCATION SERIES
ACTIVITIES FOR STUDYING HEAVENLY BODIES

Bulletin No. 247-M

Montgomery County Public Schools
Rockville, Maryland 20850
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Acting Superintendent of Schools

Table of Contents

INTRODUC'

The study of astronomy has challenged peop! ~uries, but in the modern world, students are handicapped by an artificially ~vironment. The opportunity to learn skills related to and oriented to astron ppropriate to the outdoor education program because of the extended day and t ortunity to observe unobstructed sky. It is intended that the unit serve as a cat for space age students to become motivated to further study.

This unit of astronomy for the outdoor education program consists of a series of performance objectives intended to provide interesting, hands-on activities, involving interdisciplinary skills that augment commitments of the mathematics, science, and social studies program of studies in the Montgomery County Public Schools' Goals of Education. The objectives are arranged sequentially in terms of the skills involved with daytime astronomy activities, a prerequisite to nighttime astronomy activities. They are referenced throughout the unit to the instructional objectives from different subject areas of the Program of Studies and are purposely numbered to indicate sequence and to facilitate teacher referral.

Mathematics

Whole Numbers
- II. Perform computation with whole numbers
- V. Solve problems involving whole numbers

Geometry and Measurement
- I. Use and interpret the language and symbols of geometry and measurement
- II. Describe the physical world, using the language, skills, and tools of geometry and measurement
- III. Perform computation involving measurement
- V. Solve problems involving geometry and measurement

Common Fractions
- I. Use and interpret common fractions

Science

Each student will gain knowledge of natural phenomena and their effect on man

Social Studies

Problem-solving Skills
- I. Recognize and define problems
- III. Hypothesize solutions
- V. Interpret and evaluate information
- VI. Summarize and draw conclusions

Map and Globe Reading Skills
- I. Develop ability to locate self in the immediate environment
- III. Develop concepts of spatial relationships
- VI. Develop some understanding of size and scale
- IX. Orient map and identify cardinal directions

Glossaries of stars, constellations, and terms and a bibliography are included.

Activity 1: Determining Time with a Shadow Stick

Performance Objective: The student will use a shadow stick to determine the time of day.

Program of Studies:

Mathematics: Whole Numbers, V
Geometry and Measurement, II, III, V

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Problem-solving Skills, I, III, V, VI

Procedures:

1. Select a level, open area where sunlight is not obstructed. Pound a 30 inch stake perpendicular to the center of the earth into the ground, or use a mound of plastic clay to serve as a stand for the stick.

2. Begin the marking of the shadow cast by the stick on the hour. Mark the shadow by pounding a peg into the ground at the tip of the shadow. Tie a strip of cloth from the peg to the stake. Repeat the cloth recordings each hour or a given interval of time for several hours.

Note:

Individual shadow sticks may be made with an applicator stick and plasticene clay and used on a cardboard base or on a cement or asphalt surface.

Noon sun-time is 1:08 p.m. Daylight Saving Time, Washington, D.C., area.

Materials:

30" stake or pipe
Plastic clay
Hammer
Strips of cloth approximately 1" X 1 yard
Wooden pegs or large nails

Evaluation:

Given the information of the time denoted by a specific shadow record and its time intervals, determine the time of day within 30 minutes.

Activity 2: Making and Using a Sundial

Performance Objective: The student will construct and use a simple sundial.

Program of Studies:

Mathematics: Geometry and Measurement, I

Science: Gains knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, IX

Procedures:

1. Cut along all double lines of the sundial pattern.
2. Fold the dial in half along the broken line AC.
3. Tape the edge of CG to CF.
4. Leaving the dial folded in half, fold along the dotted lines BG and BF.
5. Unfold; place the dial so that the numerals lie flat.
6. Align an azimuth circle with magnetic North of a compass.
7. Place the sundial so that the gnomon points North.

Note:

Student prerequisites are the skills of being able to locate North with a compass and learn the names of the parts of a compass.

Materials:

A copy of a sundial pattern (Appendix B)
An Azimuth Circle (Appendix A)
Scissors
Tape
Compass

Evaluation:

Position a student-constructed sundial on an azimuth circle so that the gnomon points North.

Activity 3: Finding Direction Without a Compass

Performance Objective: The student will determine North without a compass.

Program of Studies:

Mathematics:	Whole Numbers, V Geometry and Measurement, V
Science:	Gain knowledge of natural phenomena and their effect on man
Social Studies:	Map and Globe Reading Skills, IX

Procedures:

1. Select a level, open area where sunlight is not obstructed, in the morning. Pound a 30" stake into the ground perpendicular to the center of the earth.
2. Mark the lengths of the shadows every 30 minutes until afternoon.
3. Recall which shadow was the first recorded; the last shadow recorded.
4. Select the shortest shadow.
5. Determine the direction of the shortest shadow. (This indicates North.)
6. When North has been determined, locate South as opposite to North on a continuing imaginary line and East-West at right angles to the North-South line.

Note:

This activity should complement Activity 2: Making a Sundial

Student prerequisites are understanding that the sun rises in the East and sets in the West; that when the sun is at the highest point in its apparent motion across the sky, it crosses the North-South meridian; that shadows fall in an opposite line from the source of light; the concept of right angles.

Shadow lengths may be measured in various ways, such as 1) place a stone at the end of the shadow and measure the distance from the stake to the stone; 2) fasten a string or cloth strip to the stake, lay it over the shadow, cut it at the end of the shadow and place a weight on the end of the string; 3) tape string or strip of cloth to the stake and proceed with #2; or 4) use plasticene modeling clay to fasten string to the stake and to weight the ends of strings denoting shadow length.

Materials:

Hammer	Watch
30" Stake or broom handle	Selection of measuring materials

Evaluation:

State a method of determining South without using a compass.

Activity 4: Using a Watch to Locate North

Performance Objective: The student will determine North using a nondigital watch.

Program of Studies:

Mathematics: Whole Numbers, II, V
Geometry and Measurement, II, V

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, V

Procedures:

A.M. of a sunny day

1. Stand so that the sun is on the student's left. Use a pencil to cast a shadow across the center of a watch by holding the pencil against the watch rim and vertical to it.

2. Compute the angle of the shadow to 12.

3. Divide the angle by 2 to determine the North-South meridian.

P.M. of a sunny day

1. Follow the procedures used in the morning experiment except that the student will stand so that the sun shines on the watch face from the student's right side.

Note:

The degrees in a circle are 360.
The distances between the numerals on a watch face are 30°.

Materials:

Pencil
Watch
Protractor or Azimuth Circle (Appendix A)

Evaluation:

Using a nondigital watch and a pencil, point to the direction of North.

Activity 5: Measuring Angles with Fists

Performance Objective: The student will be able to approximate the angle of an object on and above the horizon using his fists.

Program of Studies:

Mathematics: Whole Numbers, II, V
Geometry and Measurement, II

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Glove Reading Skills, I, III

Procedures:

1. Stand and hold the arms and back as steady as possible. Close a fist with the thumb inside and the arm extended; curve the wrist so that four knuckles can be seen. Extend the arm toward the horizon with the little finger at eye level.

2. Look at an object in the background. Move the fist up one unit (fist) of measure until the object has been measured, counting the number of fists measured from the azimuth to the zenith.

3. Bend or straighten the arms so that it will take nine fists to measure the 90° angle.

4. Sight objects in the sky aside from the sun. Estimate the altitude of the object in degrees by counting the number of fist images necessary to reach the object and multiplying that number by 10.

5. To measure an angle on the azimuth, hold the closed fist so that 4 knuckles are horizontal with the fore knuckle directly in line of view.

6. Select an object on the horizon. Count the number of fists from North to the object and multiply by 10 to estimate degrees.

Evaluation:

Given a North bearing, approximate the degrees on the azimuth and the altitude of the top of a flagpole in degrees using a fist.

Activity 6: Measuring and Locating Sky Objects on the Azimuth

Performance Objective: The student will locate and measure a sky object in degrees.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Social Studies: Map and Globe Reading, VI

Procedures:

1. Stretch both arms shoulder high.
2. Turn around once completely in the same spot looking over the fingertips on one hand.
3. Determine the geometric shape the finger tips made during the turn.
4. Orient the model of the Azimuth Circle with North by placing a compass on the circle and aligning the N on the Azimuth Circle with the N on the compass.
5. Relate the numbers on the outer circumference of the compass to the printed Azimuth Circle.
6. Place the end of an applicator stick in plasticene on the center of the Azimuth Circle perpendicular to the center of the earth.
7. With the Azimuth Circle aligned to North, sight a named object through the applicator stick and name the degree of the object.
8. Determine the position of the sun in degrees by reading the position of the shadow made by the sun on the Azimuth Circle and locating the opposite degrees.

Note:

When a child stands, his body is perpendicular to the center of the earth.

This activity can be used to locate and measure the moon in degrees when it is in the daytime sky.

Materials:

Azimuth Circle mounted on cardboard (Appendix A)
Compass
Applicator stick and plasticene

Evaluation:

Using a model of the Azimuth Circle, locate a named object within 5 degrees.

Activity 7: Making a Simple Astrolabe

Performance Objective: The student will construct a simple astrolabe.

Program of Studies:

Mathematics: Whole Numbers, V
Geometry and Measurement, V
Common Fractions, I

Procedures:

1. Assemble materials.

2. Fasten the protractor to the strip of wood by nailing 2 half-inch nails against each outside corner of the protractor.

3. Nail the 5/8 inch nail into the wooden strip through the small hole of the protractor opposite the 90° angle marking.

4. Tie the string to the 5/8 inch nail so that it swings free of the protractor.

5. Tie the washer or metal nut to the free end of the string low enough that the weight can swing free.

6. Nail the finishing nail into one small end of the wooden strip, parallel to the zero degree line of the protractor.

Materials:

One 6" plastic protractor having a hole opposite the 90° mark
One 1" X 1" X 7" strip of wood
Four 1/2" nails
One 5/8" nail
One 1 1/2" finishing nail
8 inches nylon string
Washer or metal nut
Hammer

Evaluation: Evaluate the construction of an astrolabe by comparing it with a teacher-approved model.

Activity 8: Measuring Objects Above the Azimuth

Performance Objective: The student will be able to measure the height of an object in degrees.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Social Studies: Map and Globe Reading Skills, III

Procedures:

1. Hold an astrolabe so that its pendulum hangs at 90°.

2. Bring the end of the astrolabe not having a nail up to the sighting eye.

3 Sight a telephone pole, tall tree, or other object above the horizon by looking along the line of the protractor on the astrolabe.

4. Tilt the astrolabe until this line is aligned with the top of the object being sighted.

5. Read the degrees that the pendulum has moved from 90°.

Materials:

Astrolabe (See Activity 7: Making a Simple Astrolabe.)

Evaluation:

Determine the altitude of an object that gives a 60° reading on an astrolabe.

Activity 9: Using an Astrolabe to Measure the Angle of the Sun's Rays

Performance Objective: The student will use an astrolabe to measure the altitude of the sun's rays.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Procedures:

1. Select a sunny day, but work with the student's back toward the sun.
2. Hold the astrolabe so that the pendulum hangs free and passes through 90^{o} on the protractor.
3. Hold the pointer nail toward the student's chest.
4. Move the astrolabe so that the sun shines on the pointer nail; then tilt the astrolabe until there is no visible shadow made by the pointer nail.
5. Read the degree through which the pendulum now passes.
6. Compute the difference between the degree read and 90^{o} to determine the angle of the sun's rays and the altitude of the sun.

Note:

The straight edge of the astrolabe represents the surface of the Azimuth Circle.

A flashlight beam can be used to represent the sun during inclement weather.

Materials:

Astrolabe (See Activity 7: Making a Simple Astrolabe.)

Evaluation:

Demonstrate the use of the pointer nail on an astrolabe to determine the altitude of the sun.

Activity 10: Determining the "Altazimuth" of Objects

Performance Objective: The student will use circles to determine the "altazimuth" of sky objects.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Social Studies: Map and Globe Reading Skills, I, III

Procedures:

1. Use the daytime moon or nighttime moon or planets as the sky objects. Do not use the sun.
2. Align the azimuth circle with North using a compass.
3. Determine the azimuth of the sky object.
4. Record degrees.
5. (Alternate: See note.) Place the interlocked protractor models representing the celestial dome so that one straight edge is aligned with the azimuth.

   or

   Determine the altitude of the sky object in degrees using an astrolabe.
6. Determine the "altazimuth."

Note:

This activity is an alternate activity to Activity 8: Measuring Objects Above the Azimuth.

Step 5 (Alternate) can be an indoor practice method.

The position of a sky object is stated in degrees: first stating position in the azimuth, then altitude, such as 135^{o}, 32^{o}.

Materials

Compass
Azimuth circle mounted on cardboard (Appendix A)
Cardboard intersecting protractors (alternate activity) (Appendix D)
Astrolabe

Evaluation:

Using a compass and an astrolabe, determine the "altazimuth" for a sky object designated by the instructor.

Activity 11: Making a Model of Our Solar System

Performance Objective: The student will make a model of our solar system that will show the relative size and spacing of the planets.

Program of Studies:

Mathematics: Geometry and Measurement, V

Science: Knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III, VI

Procedures:

1. Tape a card to the ball and label the card Sun.
2. Glue or tape and label each other planet model to a card.
3. Puncture a nail through each card so that it can be placed in the ground as a sign.
4. Rearrange the models in the order in which each appears in the universe.
5. Choose a large open area, more than half mile, to demonstrate the distance between the planet models. Use a compass to determine a straight line to pace off. Place each model as a signpost in the following order:

Sun	- one end of model line
Mercury	- 10 paces from sun
Venus	- 9 paces from Mercury
Earth	- 7 paces from Venus
Mars	- 13 paces from Earth
Jupiter	- 94 paces from Mars
Saturn	- 113 paces from Jupiter
Uranus	- 253 paces from Saturn
Neptune	- 300 paces from Uranus
Pluto	- 200 paces from Neptune

6. Retrace the trail and retrieve all labeled models.

Note:

The pins can be stuck through the cards, the points taped to the back, leaving the pinhead exposed.

Clay may be substituted for the models, except the sun.

It is helpful if the student understands the relationship between diameter and circumference.

It should be emphasized that the solar system does not end with Pluto but extends to nearly 1,000 miles on the scale being used.

A pace: the distance travelled in two walking steps.

Activity 11, cont.

Materials:

Tape
Glue
Ten 3 X 5 cards
Metric ruler or British ruler
Ten large nails
Compass
Objects to represent the planets:

Object	Planet	Metric Size	English Size
Ball	Sun	20.3 cm diameter	8 inches diameter
3 Straight Pins	Mercury Mars Pluto	2. mm	.03 inch
2 Peppercorns	Venus Earth	3. cm	.08 inch
1 Chestnut or Gooseberry	Jupiter	23. mm or 2.3 cm	.9 inch
1 Filbert or Acorn	Saturn	18. mm or 1.8 cm	.7 inch
2 Peanuts	Uranus Neptune	7.5 mm	.3 inch

Evaluation:

Compare the distances between Mercury and Venus to Venus and the Sun.

Compare the size of the models of a) Earth and Venus, b) Earth and Jupiter, c) Mars and Uranus.

Activity 12: Constructing and Using a Spectroscope (Rectangular and Cylindrical Types)

Performance Objective: The student will be able to construct and use a spectroscope.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Science: Knowledge of natural phenomena and their effect on man

Procedures for rectangular type:

1. Cut along all solid lines of the pattern that has been traced onto thin cardboard.
2. Use an Xacto knife to remove the 6 rectangles indicated with diagonal lines.
3. Carefully score the dotted lines to facilitate folding but do not cut through.
4. Fold along the 4 long fold lines.
5. Overlap the 2 long outside rectangles and tape, forming a rectangular column.
6. Center the diffraction grating on the inside of the smaller square; tape around the edges.
7. Close the end of the column as a box, with the larger square the final one to enclose that end.
8. Close the opposite end of the column, with the smaller rectangle the final one to enclose the end.
9. NEVER look directly at the sun through the spectroscope.
10. Hold the spectroscope close to your eye and look through the slit toward different light sources such as an incandescent light, a flourescent light, neon light, or a white wall in bright sunlight.

Note:

This is one way of viewing the wavelengths of light from a star given off by the different elements being heated to high temperatures.

Materials:

Thin cardboard
Pattern for rectangular spectroscope (Appendix C)
Masking tape
Several light sources

Scissors
Xacto knife
Metric ruler
Transmission diffraction grating*
(2 cm X 2 cm)

* Source of Transmission Diffraction Grating, 8 X 11 - Edmund Scientific

Activity 12, cont.

Procedures for cylindrical type:

1. Roll and tape the piece of construction paper to form a cylinder about 3 mm in diameter, or use a paper towel tube.

2. Tape the diffraction grating over one end of the tube along the edges so that light can pass through the grating.

3. Cover the other end of the cylinder with a piece of dark construction paper in which a slit 1 mm has been cut.

4. NEVER look directly at the sun through the spectroscope.

5. Hold the spectroscope close to your eye and look through the slit toward different light sources such as an incandescent light, flourescent light, neon light, or a white wall in bright sunlight.

Materials:

Dark construction paper and tape or paper towel tube
Transmission diffraction grating (2 cm X 2 cm)*
Scissors
Metric ruler
Several light sources

Evaluation:

Record the following observations when the spectroscope is used to look at 3 light sources:

Light Source A	Light Source B	Light Source C

List: The colors seen
The order in which colors appear from left to right on the band
Estimate the width of different colors along the band

* Source of Transmission Diffraction Grating, 8 X 11 - Edmund Scientific

Activity 13: Determining Cardinal Directions at Night

Performance Objective: The student will find cardinal directions and use them for map reading.

Program of Studies:

Mathematics: Geometry and Measurement, I, V

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III, IX

Procedures:

1. Locate the Big Dipper (Ursa Major). Draw an imaginary line between the two stars at the end of the dipper's bowl farthest from the handle. Extend the imaginary line about 5 times the distance between the 2 stars until the line hits a fairly bright star, Polaris.

2. Mark the direction of Polaris by lining up the star with one straight side of a tree. Place a stake in the ground in line with the tree. Tie one end of a piece of string to the stake. About 4 feet away, drive another stake into the ground which lines up with Polaris, the tree, and the first stake. Secure the other end of the string tightly to the second stake.

3. Mark a simple line of direction on the ground by indicating the stake near the tree as North and the second stake as South. Lay a map of the local area under the taut string so that the North and South stakes line up with the Compass Rose on the map to show surrounding land features in true direction.

Note:

When the last star in the Big Dipper's handle is either vertically above or below Polaris, the star itself is in a true North position.

The stringed stakes can be reused the following morning to review land features seen at night.

Materials:

String
Stakes
Local Map
Flashlights with red plastic on lens
Hammer

Evaluation:

Name a land object in the direction of East and a land object in the direction of North, using the line of direction made on the ground.

Activity 14: Using an Astrolabe to Measure the Altitude of Stars

Performance Objective: The student will use an astrolabe to measure the altitude of stars.

Program of Studies:

Mathematics: Geometry and Measurement, II, V

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, III

Procedures:

1. Stand facing the general direction of the star to be measured. Hold the astrolabe so that the pendulum hangs at 90° on the protractor.
2. Sight the star by looking along the line of the protractor with the end of the astrolabe not having a nail at the sighting eye.
3. Read the degrees that the pendulum moved from 90°.
4. Compute the difference of the degrees found from 90° to determine the altitude of the star.

Materials:

Astrolabe
Flashlight with red plastic on lens

Evaluation:

Calculate the altitude in degrees of the middle star in Cassiopeia using an astrolabe.

Activity 15: Observing Apparent Movement of the Stars

Performance Objective: The student will observe evidences of motion.

Program of Studies:

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III, IX

Procedures:

1. Select an observing position that has a large tree or building corner toward the south and to the viewer's right.

2. Be seated in a comfortable position against a tree trunk or other stationary object to enable the viewer to hold his head motionless in one position for a short period of time.

3. Select a star to observe fairly close in line to the tree or building to the right of the viewer. Continue to observe the selected star for a period of 2 to 5 minutes. Compare the results of his observation with others who have participated in the activity.

4. Repeat the procedure using a planet.

Note:

The student should be able to locate North either by locating Polaris or with a compass. The student should understand that the direction South is opposite to North.

Materials:

Watch

Evaluation:

Compare the apparent movement of an observed star and planet using a fixed object as the baseline.

Activity 16: Photographing Star Trails

Performance Objective: The student will photograph star trails.

Program of Studies:

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III

Procedures:

1. Select a clear moonless night. Locate an area for the camera where there is an unobstructed view of the sky away from extraneous light.

2. Aim lens of the camera at an area of the sky to be photographed. (Note, the star, Polaris, needs no special mount.) The camera can be placed on a level tree stump, board, or cement pad.

3. Cover the lens of the camera with a 3" square of heavyweight black construction paper. Set the lens opening at its widest focus, i.e., infinity. Set the camera shutter for a timed exposure or press the shutter open and tape the button to an open position with masking tape. Carefully remove the piece of black construction paper without jarring the camera.

4. Leave the shutter open from 1 to 6 hours.

5. Place the black paper over the lens to close the shutter, then release the shutter button.

Note:

The length of time of exposure will affect the length of star trails on each photograph.

Materials:

Black and white film
Camera (not an Instamatic)
Masking tape
Black construction paper or felt
Board or tripod

Evaluation:

Write a summary to accompany the photograph of a star trail. Include camera type, film type, date, time period of exposure, direction lens viewed, and explanation of star trail.

Activity 17: Observing Meteors

Performance Objective: The student will identify meteors.

Program of Studies:

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III, IX

Procedures:

1. Select a clear night sky.
2. Be seated in a comfortable position where there is an unobstructed view of the northeastern sky. Scan the sky slowly at an angle of about 20^{o} from zenith.

Note:

Meteor showers occur in frequence during the following time periods: August 9 - 12, October 10 - 23, and December 10 - 13. Sunrise is also an outstanding time to watch for meteors. The student should know that a meteor is sometimes refered to as a "shooting star" and that he is looking for fast movement in the sky. The star will appear to drop rapidly, then burn out.

Materials:

None

Evaluation:

Record the following information of a meteor shower:

1. Constellation in or near which shower originated
2. Date
3. Time
4. Number seen
5. Direction from viewer
6. Direction meteor appeared to be falling

Activity 18: Locating Polaris, Ursa Major, Ursa Minor, and Cassiopeia

Performance Objective: The student will be able to locate Polaris and the constellations Ursa Major, Ursa Minor, and Cassiopeia in relationship to each other.

Program of Studies:

Science: Gain knowledge of natural phenomena and their effect on man

Social Studies: Map and Globe Reading Skills, I, III, IX

Procedures:

1. Use a compass to locate North in an unobstructed area.

2. Face North. Extend one arm to the Northern horizon. Point the other arm straight up to zenith. Lower the upraised arm to a position half-way between overhead and the horizon and extend a finger. Locate the bright star toward which the finger points.

3. Look in the vicinity of Polaris for seven stars that resemble the silhouette of a water dipper. Locate the handle of the Big Dipper, the bowl, and the two stars called Pointer Stars.

4. Extend an imaginary line from the Pointer Stars to Polaris, as a confirmation of Step 2.

5. Note the position of the Big Dipper relative to Polaris. Check the position of the Big Dipper an hour later to determine whether the star group appeared to move clockwise or counterclockwise.

6. With Polaris as the tip of a handle, locate the Little Dipper, Ursa Minor, that has seven stars and appears to be pouring into the Big Dipper.

7. Extend an imaginary line from the end star in the handle of Ursa Major, through Polaris, an equal distance past Polaris, and locate a constellation shaped like a W or M, named Cassiopiea.

Notes:

Other names for Polaris are "North Star" and "Polestar."

Show the student a water dipper or ladle with a straight handle. Explain the use of the dipper in days past. Using the dipper, describe Ursa Major by its 2 main parts, the handle with 3 stars and the bowl with 4. Demonstrate pouring from the dipper in a forward manner to emphasize the position of the Pointer Stars.

Show that with the rotation of the earth the constellation will change position (rotate the metal dipper counterclockwise) but will always be in the northern sky.

The formal name of the constellation of which the Big Dipper is a part is Ursa Major, meaning "greater bear." The paws are marked by 3 pairs of stars and a nose which is a bright star.

Activity 18, cont.

Another informal name for Ursa Major is the Drinking Gourd.

Because of viewing conditions, Ursa Minor is more difficult to locate.

Materials:

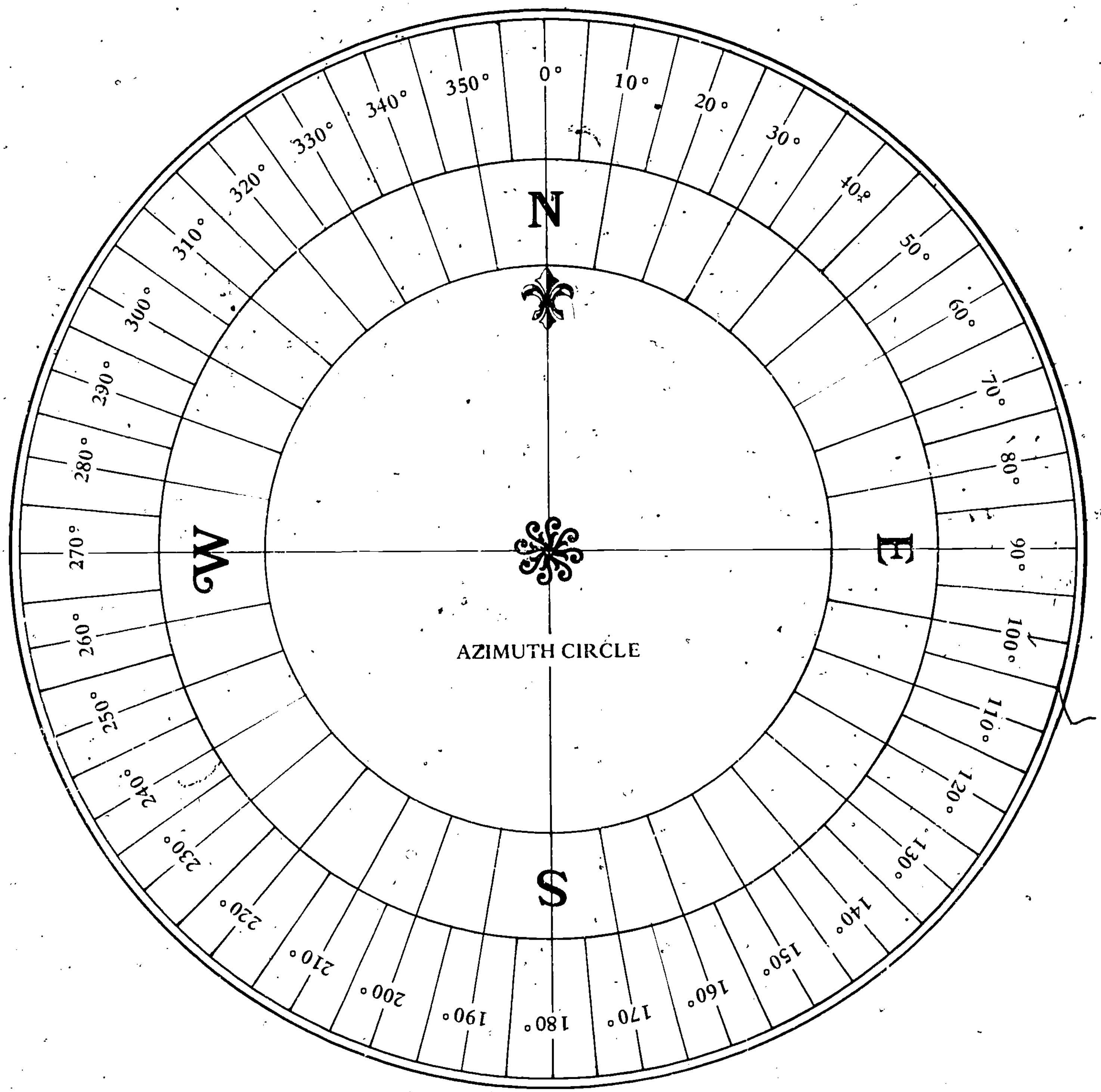
Compass
Flashlight with lens covered with red or yellow cellophane or plastic
Dipper or ladle
Watch

Evaluation:

Draw 19 x's on graph paper to indicate the relative positions of the stars in Polaris, Ursa Major, Ursa Minor, and Cassiopeia.

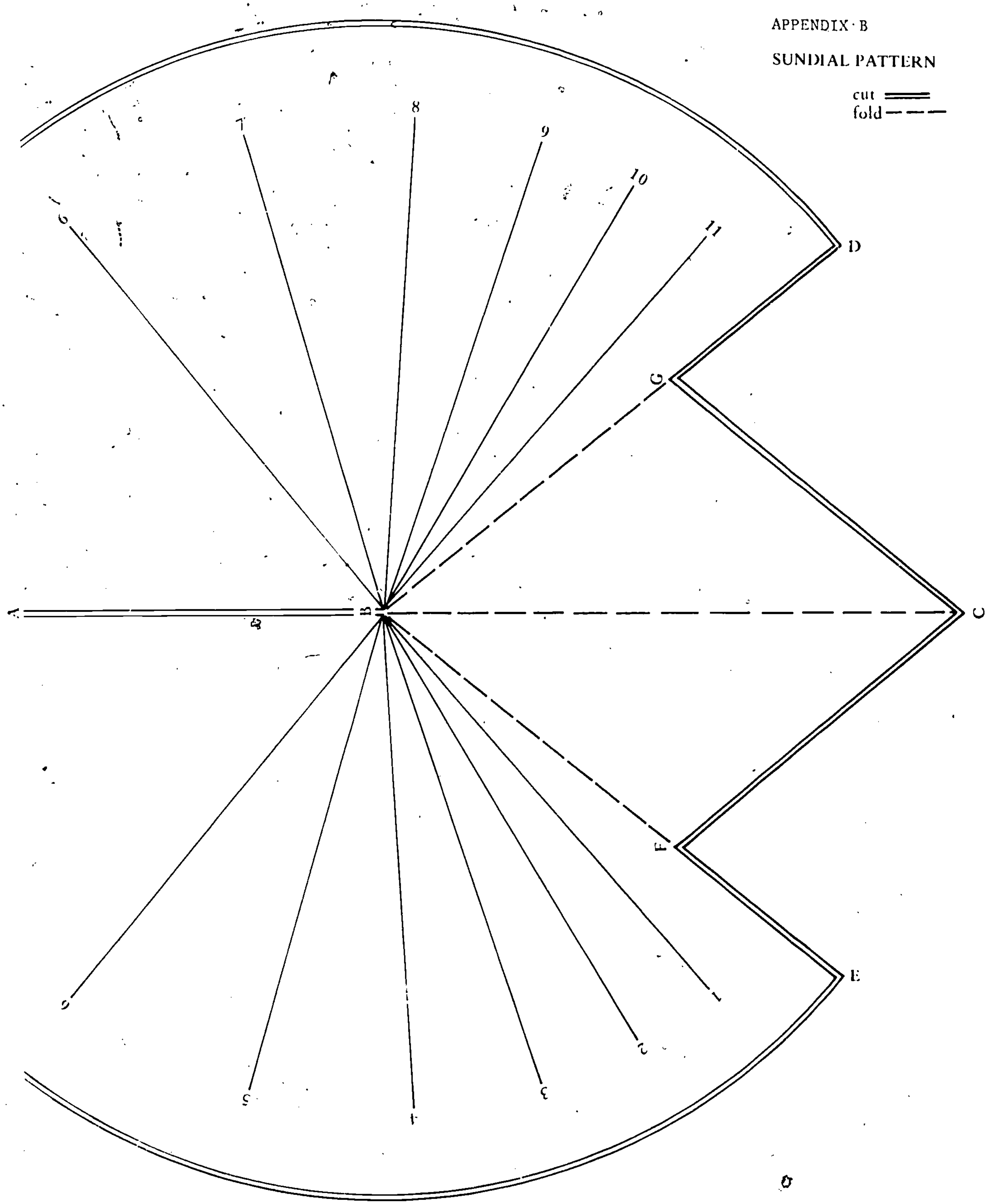
APPENDIX A

AZIMUTH CIRCLE



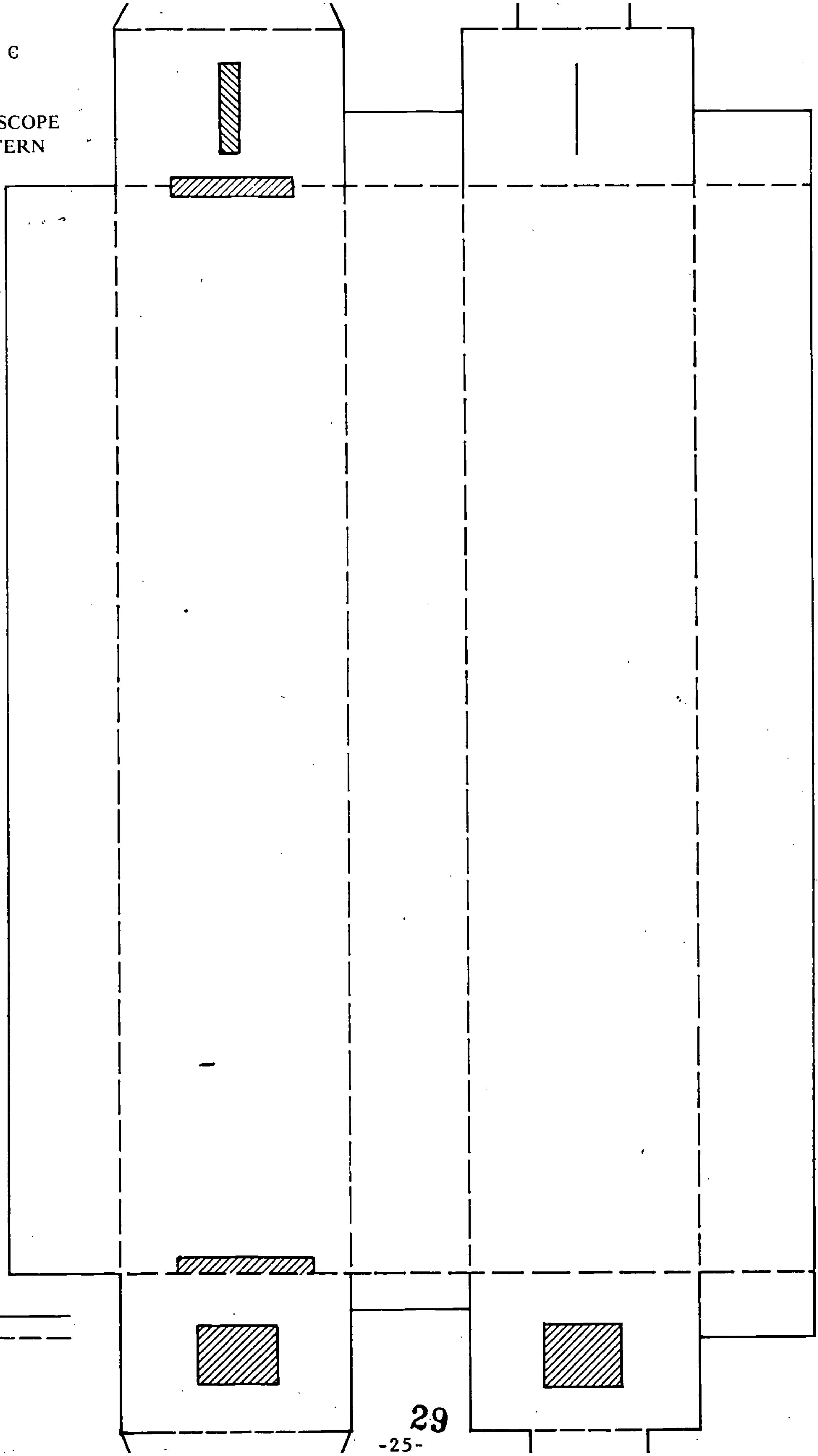
APPENDIX B

SUNDIAL PATTERN



APPENDIX C

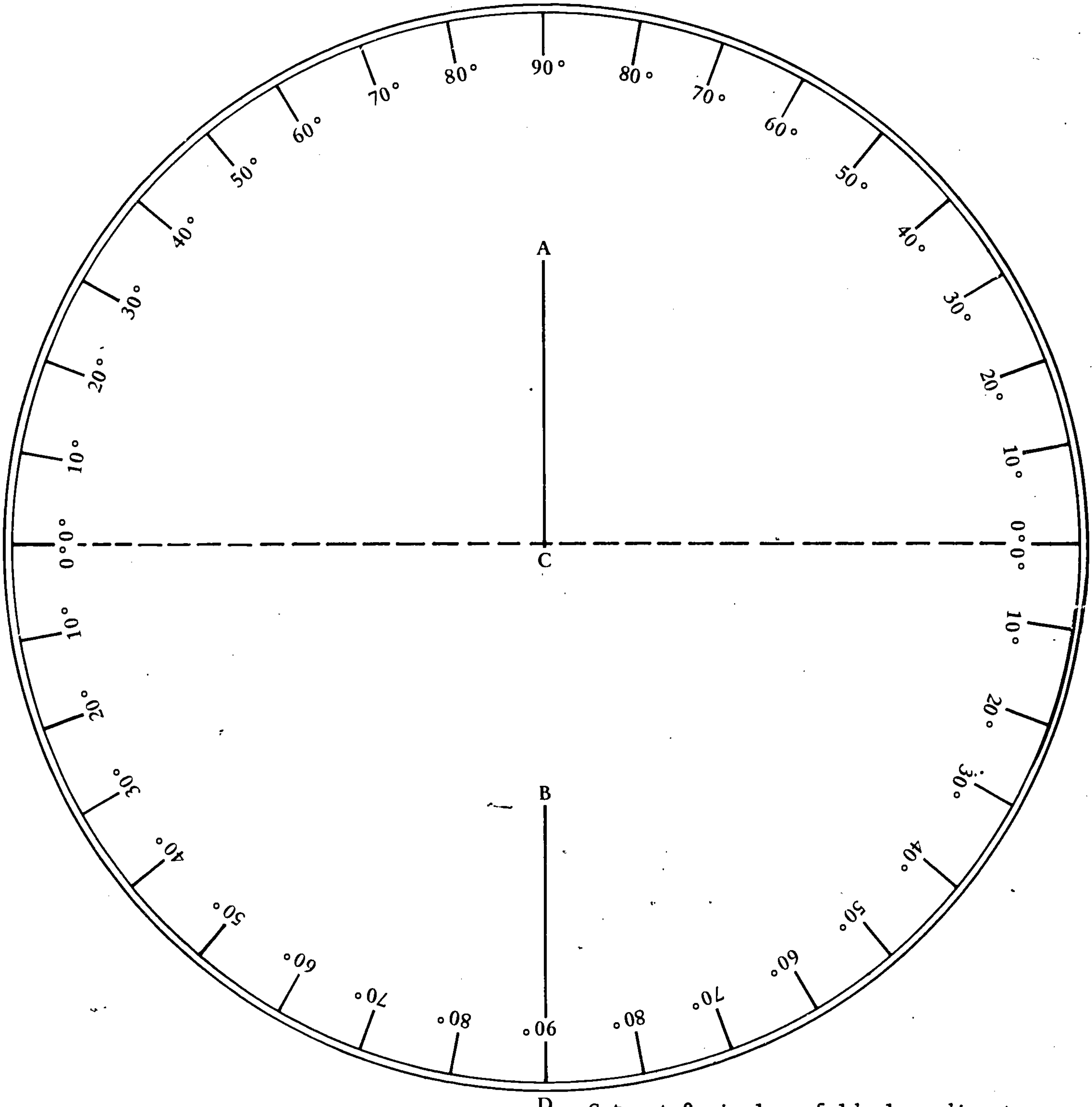
SPECTROSCOPE
PATTERN



cut ————
fold — — —

PROTRACTOR PATTERN

APPENDIX D



Cut out 2 circles; fold along diameter of both.
Cut line segment AC on one circle.
Cut line segment BD on the second circle.
Insert AC into BD.

APPENDIX E

GLOSSARY

"altazimuth" - a contraction of the words altitude and azimuth. Placement of an object on the azimuth circle and at a given altitude.

"altazimuth" circle - a circle perpendicular to the center of the earth that passes through the zenith and nadir of the viewer.

altitude - the angular distance of an object above or below the horizon measured degrees, minutes and seconds of arc.

astrolabe - an instrument used to measure angles in degrees.

azimuth - the position of a sky object measured in degrees horizon ılly starting from North.

azimuth circle - an expanding or contracting circle horizontal to the center of the earth that measures the position of a sky object in degrees, starting from 0°, North.

Big Dipper - a portion of Ursa Major; also known as the Great Bear or Drinking Gourd .

celestial equator - intersection of the plane of the earth's equator with the celestial sphere.

celestial sphere - a spherical surface on which the stars and planets appear to lie.

circumference - the perimeter of a circle.

constellation - a configuration of stars named by the ancients to delineate areas of the sky.

declination - angular distance of a celestial body marked N and S to show whether the body is North or South of the celestial equator. Plus or minus show the direction the sun is apparently traveling in its annual movement.

diurnal - daily.

diurnal circle - the path of a star due to the daily rotation of the earth.

ecliptic - path of the sun on the celestial sphere.

equator - midpoint of a line connecting the North and South Poles.

galaxy - an independent assemblage of many stars.

gibbous phase - phases of moon or planets where more than half the surface is illuminated, but not all.

gnomon - a tall, thin object that casts a shadow when the sun shines on it.

Greenwich meridian - origin for longitude.

horizon - the place where the sky and earth seem to meet.

International Date Line - an arbitrary line roughly 180° from the Greenwich meridian across which the date changes by a day.

latitude - angular measurement from the equator N and S to the geographical poles.

equator 0°
poles 90°

one minute of latitude is = to 1 nautical mile (6080 ft.).

Little Dipper - a portion of Ursa Minor; also known as the Small Bear.

longitude - measurement East and West from Greenwich meridian (0°) to International Date Line (180°).
One minute of longitude.

meridian (1) great imaginary circle on the surface of the earth containing the observer and the poles; (2) great imaginary circle on the celestial sphere, containing the observer's zenith and the celestial poles.

meteor - a particle of matter in the solar system observable when it falls into the earth's atmosphere where friction causes incandencence (burning).

nadir - the lowest point of the celestial sphere directly beneath where one stands, opposite of zenith.

protractor - a device for measuring angles.

spectroscope - an instrument used to break a light ray into its wave lengths.

sundial - an instrument to show the time of day by the shadow of a gnomon.

sunspot - one of the dark spots that appears from time to time on the sun's surface.

waning - phase of the moon from the full moon to the new moon; to become less brilliant.

waxing - phases of the moon from new moon to full moon.

zenith - the point in the celestial sphere that is exactly overhead opposite of nadir.

zodiac - an imaginary band 16° wide centered on the ecliptic.

APPENDIX F

STAR AND CONSTELLATION GLOSSARY

ALCOR (accent al) Dim star almost in line with MIZAR in the handle of the BIG DIPPER

ALIOTH (alley-oth, oth rhymes with cloth) Star in the handle of the BIG DIPPER

ALTAIR (accent tair) Star in AQUILA

ANTARES (an-tair-ees, accent tair) Brightest star in SCORPIUS

*AQUARIUS (ac-kwair-ee-uss, accent kwair) Constellation of ZODIAC

AQUILA (ack-will-a, accent ack) The Eagle Constellation containing ALTAIR

ARCTURUS (ark-tew-russ, accent tew) Very brilliant star in BOOTES

*ARIES (ay-ri-eez, accent ay as in hay) The Ram in the ZODIAC

AURIGA (or-eye-ga, accent eye, the g is hard as in go) The Charioteer Constellation

BELLATRIX (bell-lay-tricks, accent lay) Star in ORION

BETELGEUSE (bett l-jews, accent bett) Red star in ORION (right shoulder)

BIG DIPPER Stars found in URSA MAJOR

BOOTES (bo-oh-teez, accent oh) The Herdsman Constellation containing ARCTURUS

*CANCER The Crab Constellation of the ZODIAC

CANIS MAJOR (kay-neez-may-jer, accent kay and may) The Greater Dog Constellation containing the most brilliant star, SIRIUS

CANIS MINOR The Smaller Dog Constellation containing brilliant star PROCYON

CAPELLA (ka-pell-a, accent pell) Very brilliant star in AURIGA

*CAPRICORNUS (accent corn) The Sea Goat Constellation of the ZODIAC

CASSIOPEIA (kass-ee-oh-pee-ya, accent pee) The Lady in the Chair; circumpolar constellation

CASTOR Star in GEMINI

CEPHEUS (see-few"ss, accent few"ss) circumpolar constellation

CYGNUS (sig-nuss, accent sig) The Swan Constellation containing the NORTHERN CROSS

DENEB (accent den) Brightest star in CYGNUS; navigation star in the summer triangle

DRACO (dray-ko, accent dray) The Dragon Constellation between BIG and LITTLE DIPPER; circumpolar

DUBHE (dubb-ee, accent dubb) Star in BIG DIPPER; one of the Pointers

FORMALHAUT (fome-al-ought, accent fome) Brightest star in Southern Fish

*GEMINI (jem-in-eye, accent jem) The Twins Constellation of the ZODIAC

*LEO (lee-oh, accent lee) The Lion Constellation of ZODIAC

*LIBRA (lye-bra, accent lye) The Scales Constellation of the ZODIAC

MERAK (mee-rack, accent mee) Star in BIG DIPPER. One of the Pointers

MINTAKA (accent min) Right-hand star in Belt of Orion

NORTH STAR Polaris

ORION (orr-rye-on, accent rye) The Hunter or Warrior Constellation

* Constellation of the ZODIAC

PEGASUS (accent peg) The Flying Horse Constellation containing the GREAT SQUARE

*PISCES (py-seez, accent py) The Fishes Constellation of the ZODIAC

PLEIADES (plee-ya-deez, accent plee) Star cluster in TAURUS

POINTER STARS Dubhe and Merak in the BIG DIPPER of URSA MAJOR

POLARIS (pole-air-iss, accent air) The NORTH STAR

POLLUX (accent poll) Brightest star in GEMINI

PROCYON (pro-see-on, accent pro) Very brilliant star in CANIS MAJOR

REGULUS (reg-you-luss, accent reg, rhymes with peg) Brightest star in LEO

RIGEL (ry-jell, accent ry) Star in ORION (left knee)

*SAGITTARIUS (sa-jitt-tair-ee-uss, accent tair) The Archer in the ZODIAC

*SCORPIUS (accent scor) The Scorpion in the ZODIAC

SIRIUS (seer-ee-uss, accent seer) Brightest star in the sky in Constellation CANIS MAJOR

SPICA (spy-ka) Brilliant star in VIRGO

*TAURUS (tore-uss, accent tore) The Bull Constellation in the ZODIAC

URSA MAJOR (ur-sa may-jer, accent ur and may) GREAT BEAR containing the BIG DIPPER, the distorted C preceding it, and the bent-in triangle under it

URSA MINOR (ur-sa my-ner, accent ur and my) The SMALL BEAR containing the LITTLE DIPPER

* Constellation of the ZODIAC

VEGA (vee-ga, accent vee, the g is hard as in go) Very brilliant star in LYRA

*VIRGO (ver-go, accent ver, g is hard as in go) The Constellation of a Woman holding a spike of grain. (The Virgin) Constellation of the ZODIAC

APPENDIX G

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